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TYPHOID VACCINATION NO SUBSTITUTE FOR SANITARY PRECAUTIONS.

Although the protective value of antityphoid vaccination is no longer open to question, the practice of this procedure should under no circumstances be regarded as a substitute for the observance of sanitary precautions. The necessity for maintaining the highest possible standards of sanitation and hygiene has just led to the publication of an instructive circular by the chief surgeon, American Expeditionary Forces. The lessons which this circular teaches are so thoroughly applicable to health officers generally that we reproduce it here in full.

TYPHOID-PARATYPHOID FEVERS.

I.—Introduction.

In view of the appearance and continued incidence of fevers of the typhoid-paratyphoid group in many units of the American Expeditionary Forces during the past five months, it is deemed essential to review this subject at the present time, particularly from the viewpoint of early diagnosis, prevention, and control.

The occurrence and distribution of typhoid-paratyphoid in our troops has constantly and continuously been brought to the attention of all medical officers serving with the American Expeditionary Forces through the medium of the weekly bulletin of diseases. It would appear, however, that many officers have utterly failed to grasp the significance of these reports and warnings, a fact which may be due to a false sense of security under the popular belief that vaccination against typhoid and paratyphoid gives a complete immunity even in the midst of gross insanitary conditions.

Notwithstanding the fact that typhoid and paratyphoid fevers are endemic in the United States, and in spite of our extensive experience with these diseases during the Spanish-American War and later during the period of mobilization on the Mexican border, it is evident that many medical officers have gained but little knowledge of the fundamental principles underlying prevention and control. It is also quite evident that some medical officers are grossly careless and neglectful of their duties and responsibilities as medical officers and sanitarians.

This office realizes fully that the United States has raised within a short period of time an army of several millions of men who have been poorly instructed in personal hygiene and sanitation; it realizes that 2,000,000 of these men have been brought to France, where they have encountered environmental conditions differing entirely from those existing in the United States; it is fully recognized that military necessity has at times rendered sanitary control extremely difficult, especially during the stress of active combat.

To our regret, be it said, the high standards of sanitation and personal hygiene set by the Medical Department during the past 10 to 15 years have not been lived up to during the past one and one-half years. This has been due to a combination of factors, the more important of which have been the lack of facilities and materials, transportation difficulties, and insufficient training and personnel. However, many medical officers serving with combatant and S. O. S. units have been able to overcome all handicaps, and have by wise counsel and by eternal vigilance succeeded in keeping their units in excellent fighting trim.

The actual physical fighting is now at an end, and the time-worn excuse that "there is a war on" will no longer be tolerated. But the fight against disease still continues.

The greater part of the American Expeditionary Forces is now relatively stationary in training areas or with the armies of occupation, where definite sanitary measures can be instituted and enforced, where instruction of the line troops can be carried out, and where opportunity is presented to initiate rules of personal hygiene. Medical officers will therefore be held responsible for the proper supervision of the health of troops.

Carbon copies of all general recommendations of medical officers covering sanitation and personal hygiene, promulgated officially as orders and memoranda by superior authority, will be mailed to this office.

II.—Summary of Typhoid-Paratyphoid Incidence in the American Expeditionary Forces.

In order that all medical officers in the American Expeditionary Forces may have a somewhat comprehensive view of the occurrence of these fevers in the American Expeditionary Forces, the following brief review is presented:

(a) From June 1, 1917, to June 1, 1918, but few cases occurred. The rate was well within the limits to be expected in view of the sanitary conditions under which the troops were of necessity living. The cases were sporadic and only occasionally did secondary cases develop.

(b) In July, 1918, a replacement unit consisting of 248 men from Camp Cody, N. Mex., reached England with typhoid prevailing extensively; 98 men, or 39.5 per cent, had typhoid, and the case death rate was 8.42 per cent.

It was evident from the investigation that the men were exposed to infection through contaminated drinking water while en route to the port of embarkation in the United States. The unit had been vaccinated a few months prior to the occurrence of the epidemic. Most of the patients presented the typical clinical features of typhoid.

The percentage of positive bacteriological findings from the blood, feces, and urine was low, as no laboratory work could be done until late in the course of the disease.

(c) In August, 1916, a small but severe epidemic occurred in a detachment of Engineer troops stationed at Bazoilles. In this unit 15 cases of typhoid occurred, with a death rate approximating 10 per cent. Typhoid was endemic in the civil population, and the epidemic was very definitely traced to a cook in the mess of this Engineer detachment, who remained on duty as a cook for five days after the onset of the symptoms. The epidemic was recognized in its early stages, and in all patients the disease was confirmed bacteriologically by positive cultures from the blood and feces.

(d) During the Chateau-Thierry offensive diarrheal diseases were very prevalent in the troops engaged—approximately 75 per cent. It was demonstrated bacteriologically in this area that the prevailing intestinal diseases were simple diarrhea, bacillary dysentery, typhoid, paratyphoid A and B. The sick and wounded from this sector were evacuated to base hospitals in various parts of France. Very soon thereafter this office began to receive reports of cases of typhoid, paratyphoid, and bacillary dysentery from base hospitals. In practically all instances the patients had been evacuated from the Chateau-Thierry sector. The high incidence of intestinal diseases in this sector was due to the entire disregard of the rules of sanitation. "Military necessity" and the impossibility of supplying auxiliary labor troops at that time prevented immediate police of the battle fields. In some of the cases involved in this series the diagnosis of dysentery or typhoid was made by the pathologist at autopsy. The percentage of positive bacteriological findings was low, as the correct diagnosis, if made, was not usually arrived at until late in the course of the disease.

(e) Both dysentery and typhoid-paratyphoid fevers were demonstrated to have prevailed to some extent in our troops after the St. Mihiel offensive, but the epidemics of influenza and pneumonia prevailing at that time overshadowed all other medical admissions.

(f) Following the offensive in the Argonne sector, typhoid and paratyphoid began to be reported from practically all divisions engaged in that offensive. It is quite evident that the initial cases were due in large part to drinking infected water. The initial cases, however, in large part were not, in most instances, promptly diagnosed, and secondary cases from contact began to occur. In some divisions either the initial exposure was not great, the organizations were under good discipline, or the medical officers had a proper conception of their duties and responsibilities and but few cases occurred. In other instances the contrary was true and many cases have occurred. As examples of the two extremes, may be cited the —

Division, in which 5 cases occurred between October 1, 1918, and February 1, 1919, and the — Division, in which 115 cases occurred in the same period.

More than 300 cases of typhoid-paratyphoid may be attributed to the Argonne offensive. Eight hundred and seventy-four typhoids and paratyphoids have been reported in the American Expeditionary Forces since October 1, 1918. The percentage of confirmatory laboratory diagnoses has been low on account of the fact that the clinicians frequently failed to suspect the disease in its early stages.

(g) A small but severe epidemic occurred in the Joinville concentration area in December and January. In a group of Medical Department units (evacuation and mobile hospitals and sanitary trains) concentrated there 75 cases occurred, with a case death rate of approximately 20 per cent. The cases were suspected in the early stages of the disease and the percentage of positive findings by culture of urine or feces has been greater than 75 per cent. The cause of this epidemic has not been completely analyzed as yet, but there is but little question that it was due to the use of infected drinking water.

III.—Reports of Cases.

If epidemics are to be recognized in their incipency and measures initiated to control and prevent further extension, it is manifestly of the utmost importance that reports of suspects and proven cases be transmitted to the medical officers of organizations directly concerned at the very earliest possible moment. The large number of troops involved, methods of evacuation, delays in transmission of reports, necessary censorship regulations, frequency of troop movements, laxity in making reports, unwarranted delay in making diagnoses, and other factors have tended to hamper this most important instrument for the control of transmissible diseases. The medical officers charged with the supervision of the health of all organizations must know at the earliest possible moment of the diagnosis or provisional diagnosis of typhoid or paratyphoid in a member of his organization, and for this diagnosis he must depend on the ward surgeon in the camp, evacuation, mobile, base, or other hospital unit to which the patient has been evacuated. Ward surgeons and chiefs of medical service in hospitals charged with the care of these patients do not appear to comprehend their responsibility in this matter. As a matter of fact, they are jointly responsible with the medical officer of the organization for any epidemics occurring in a command if they delay, in the least, in making diagnoses or in reporting suspects or positive cases. The records of this office show that patients with typhoid have passed successively through camp, field, evacuation, and base hospitals without any documentary evidence that typhoid or paratyphoid was even suspected. There are records of a stay of

two weeks or more in a single base hospital without diagnosis, and not a few records are on file showing that it remained for the pathologist to make the diagnosis at the autopsy table. If a tentative or positive diagnosis of typhoid or paratyphoid does not reach the medical officer of an organization until two to three weeks after the evacuation of the individual from the command, the damage already is done, additional individuals already are infected, and the problem of control becomes all the more difficult. If, on the contrary, ward surgeons in hospitals are keenly alive to their duties and responsibilities, will suspect typhoid and paratyphoid in all fevers of undetermined origin, will endeavor to confirm their suspicions by early blood culture, will promptly report all clinical cases as such and positive cases as such, the necessary information can be transmitted immediately to the medical officer of the organization concerned, who can in turn institute measures for the prevention of secondary cases.

In order that reports of cases of typhoid and paratyphoid may be transmitted more promptly to the medical officer attached to organizations, the following procedure will be adopted:

(a) Commanding officers of Medical Department units caring for the sick will be held responsible for reporting promptly by telegraph, as already provided for in Section XII, Sick and Wounded Reports, all suspected, clinical, and proved cases of typhoid and paratyphoid. The commanding officers of such hospitals will hold the chiefs of their medical services directly responsible for the prompt submission of diagnoses in these cases. Any laxity or incompetency in this respect will be immediately reported to this office for necessary action.

(b) When reporting these cases, in addition to the data now required by telegraph, the word "onset" followed by the date of appearance of the initial symptoms of the disease will be included in each case. The "onset" or appearance of the initial symptoms will be obtained by careful inquiry into the history. In securing these data it must be understood that the date of "onset" is not necessarily the day on which the patient first reported sick or the date on which he was admitted to hospital, but rather should be regarded as the day when the patient first had any symptoms indicative of the disease.

(c) In reporting cases of typhoid or paratyphoid, in compliance with paragraph (a) above, the following classification will be observed:

1. All suspected cases of typhoid and paratyphoid will be reported as "Typhoid or paratyphoid suspect."
2. All cases which present a clinical picture of these diseases will be reported as clinical typhoid or paratyphoid, using the term "Clinical typhoid or paratyphoid."

3. All cases in which the diagnosis of typhoid or paratyphoid has been confirmed by bacteriological methods or autopsy will be reported as "Proved typhoid or paratyphoid."

4. Individuals who are found to be excreting typhoid or paratyphoid bacilli in their stools or urine and who have recently had a febrile disease presenting the clinical symptoms of typhoid or paratyphoid, will be reported as "Convalescent typhoid or paratyphoid carriers."

5. Individuals who are found to be excreting typhoid or paratyphoid bacilli in their stools or urine but who have not been sick recently with a disease resembling typhoid or paratyphoid will be reported as "Typhoid or paratyphoid carriers."

6. Cases originally reported as suspects or clinical cases of typhoid or paratyphoid and which have subsequently been proved, by laboratory methods or autopsy, to be one of these diseases will be again reported, stating that they are now proved cases. The telegram reporting such proved cases will indicate clearly that they have formerly been reported as suspects or clinical cases.

7. If cases originally reported as suspects or clinical typhoid or paratyphoid are subsequently found not to have been one of these diseases, these cases will be reported by telegraph, showing change of diagnosis. In all telegrams reporting such change of diagnosis definite information will be submitted indicating that they have been reported previously as suspects or clinical cases.

(d) All reports outlined above will be sent by telegraph to the chief surgeon, American Expeditionary Forces. If the hospital unit reporting such cases is attached to one of the armies a duplicate of this report will be submitted to the chief surgeon of the army concerned, in such manner as he may indicate. If the hospital unit is under the orders of a section surgeon, surgeon of the District of Paris, or surgeon of the American embarkation center at Le Mans, a duplicate of this report will be submitted to the section, district, or embarkation center surgeon, in such manner as he may indicate.

Chief surgeons of the armies will establish close liaison with base, evacuation, and camp hospitals in the immediate vicinity of their commands, but not a part of their commands, to which patients from their commands are to be evacuated. If cases of typhoid or paratyphoid from armies are diagnosed in such camp, evacuation, base, or other hospitals, the commanding officers of such units will, in addition to the reports called for above, make immediate report of such cases by telephone, telegraph, or courier to the chief surgeon of the army concerned.

8. The special attention of all medical officers is invited to section 189, Article III, Manual Medical Department, quoted below, which will be strictly complied with:

"189. A report will be furnished in every case of typhoid fever or paratyphoid fever occurring in an officer, enlisted man, or civilian employee who has received the typhoid vaccine, describing in detail the method of arriving at diagnosis."

Special blank forms covering the information to be submitted will be obtained on request to this office.

IV.—Clinical Diagnosis of Typhoid and Paratyphoid Fevers.

In view of the fact that the ordinary clinical picture of typhoid-paratyphoid is very frequently profoundly modified in vaccinated individuals, it is considered essential to enumerate briefly the usual clinical manifestations of these fevers, atypical modes of onset, differential diagnosis, and modifications of the usual clinical manifestations in vaccinated individuals.

1. *Clinical manifestations of typhoid and paratyphoid.*—Typhoid fever in the unvaccinated is commonly characterized clinically by symptoms due to the gradual development of a general bodily infection. The onset is insidious, with lassitude, malaise, gradual steplike rise in temperature with slight morning remissions until at the end of the first week a continuous fever of from 103° to 105° F. has been attained. The beginning of the attack is usually associated with anorexia, headache, and frequently with diarrhea, abdominal distress, and epistaxis. The pulse is not increased in proportion to the temperature, is of low tension and dicrotic. The tongue is coated and white and the abdomen distended and tender. From the seventh to the tenth day the rash appears in the form of slightly raised, flattened papules of from 2 to 4 mm. in diameter, which can be distinctly felt, are of a rose-red color, and fade on pressure. These rose spots, characteristic of typhoid and paratyphoid, appear singly or in crops, usually first on the skin of the abdomen and lower thoracic region, but may occur only on the back or extremities. The individual rose spot persists for from two to three days, after which it fades, leaving a brownish stain which persists for some time. Toward the end of the first week the spleen enlarges and its edge can be distinctly felt below the costal margin.

At the end of 10 days the symptom complex clinically characteristic of typhoid—continuous fever, rose spots, and enlarged spleen—is usually established. To this should have been added laboratory findings of absence of leucocytosis and in the majority of instances a positive blood culture, which occurs most frequently during the early stage of the disease. One negative blood culture will not suffice, but repeated examinations at 48-hour intervals will be made in suspicious cases.

During the second week there is continued high fever with slight morning remissions. The pulse becomes rapid and loses its dicrotic

character, the patient becomes dull and stupid, the lips are dry, the tongue is dry and covered with a dirty brownish coat and tremulous. Abdominal symptoms when present—tyimpanites and diarrhea—are more pronounced and the clinical picture becomes one of intense toxemia. In the third week, in favorable cases, the morning remissions in temperature become more marked, the fever becomes distinctly remittent in type and toward the end of this period a gradual fall in temperature by lysis is noted. Rose spots cease to appear. In severe cases the pulse is weak, ranging from 110 to 130, and pulmonary complications, especially pneumonia and hypostatic congestion, may occur. The patient is dull and apathetic, and low-muttering delirium and subsultus tendinum are common. During the fourth week convalescence begins, the temperature gradually reaches normal, the abdominal symptoms subside, the tongue becomes clear, and the desire for food returns. In severe cases convalescence may be delayed until the fifth or even the sixth week, in which case the fever continues high during the fourth week and it is only toward the end of this period that marked daily remissions make their appearance.

In individuals previously vaccinated against typhoid but who have completely lost their immunity, infection similar to that found in the unvaccinated occurs, giving rise to the symptom complex described above as characteristic of typhoid fever.

Infections occurring in the vaccinated individual who still possesses a certain degree of resistance to infection result in the appearance of atypical clinical pictures, such as abortive types of typhoid and paratyphoid in which the constitutional symptoms are mild, with but slight febrile reaction of atypical type and few if any rose spots. The onset may be either insidious with headache, loss of appetite, and fatigue, or acute and associated with chills, vomiting, intestinal cramps, and diarrhea. Fever may be wholly absent or evanescent in character and determined only if observations are made within the first 48 to 72 hours. A low type of temperature, with daily fluctuations of from 98.6 to 100.4 suggestive of the presence of tuberculous disease may persist for a week to 10 days. It is in this class of cases that blood cultures taken early in the course of the disease, and repeated if negative, frequently give definite information concerning the nature of the infection. Ambulatory types of typhoid are not uncommon and the first indication of the existence of the disease may be furnished by the occurrence of intestinal hemorrhage or perforation.

The vaccinated individual protected against general systemic infection may still act as a carrier of typhoid infection, and frequently shows clinical manifestations of local disease of some portion of the gastrointestinal tract, while the characteristic symptom complex of

typhoid fever due to general infection, namely, continued fever, rose spots, and enlarged spleen, may be wholly absent.

2. *Distinctive complications.*—Intestinal hemorrhage occurs usually during the third or fourth week. The onset is marked by a sudden and frequently pronounced fall in temperature associated with increased gravity of the general condition and a rise in pulse rate.

Intestinal perforation occurs usually during the third or fourth week. Patients whose sensorium is not too clouded complain of sudden paroxysmal abdominal pain, usually referred to the right hypogastric region. Signs of peritoneal irritation rapidly become manifest. Vomiting is common. Hiccough and irritability of the bladder with frequent micturition may be noted. Physical examination of the abdomen reveals tenderness and muscle rigidity, most marked in the right hypogastric or iliac region. Obliteration of liver dullness is frequently present and constitutes an important sign. Acute abdominal symptoms associated with a suddenly appearing leucocytosis are indicative of perforation. The occurrence of intestinal hemorrhage or signs of intestinal perforation in an individual giving a history of previous ill health should always lead to the suspicion of the existence of typhoid.

3. *Atypical modes of onset.*—(a) Acute onset with symptoms simulating meningitis. Lumbar puncture differentiates.

(b) Acute onset with intense, usually generalized bronchitis or symptoms suggestive of lobar or broncho-pneumonia.

(c) With chills, fever, vomiting, cramplike pain in abdomen, sometimes localized in right iliac fossa and suggesting appendicitis.

(d) With symptoms of acute nephritis. Attack begins suddenly with nausea, vomiting, pain in lumbar region, diminution in secretion of urine, which is highly colored, and contains albumin and casts.

(e) Special mention should be made of the ambulatory type of typhoid, in which the symptoms are slight, consisting simply of headache and lassitude associated with mild gastrointestinal disturbances. The patient is at no time confined to his bed and intestinal hemorrhage or perforation may furnish the first clue with regard to the existence of typhoid.

(f) In the above atypical modes of onset early blood cultures are of importance in differentiation.

4. *Paratyphoid fevers.*—The paratyphoid fevers due to infection with A or B organisms are evidenced clinically by the same general symptomatology as that of typhoid. They, however, as a rule run a much milder course and the intense toxemia of typhoid, evidenced by marked apathy, muttering delirium, and subsultus tendinum, is seldom present. The onset of paratyphoid is frequently more abrupt, with acute gastrointestinal symptoms resembling food

poisoning. The intestinal symptoms are as a rule more marked in cases of infection with paratyphoid B than in cases in which paratyphoid A is the causative factor. The fever in paratyphoid is not of as long duration, nor is it as continuous as in typhoid, but is more distinctly remittent in type. Enlargement of the spleen, rose spots, and absence of leucocytosis are, as a rule, present in all three infections. Attempts have been made by some authorities to distinguish between the eruptions of paratyphoid A, paratyphoid B, and typhoid. Thus the spots in paratyphoid A are said to be larger, more macular in type, of a darker reddish hue, and to correspond more closely to the eruption of measles. However, histologically the rash is the same in all three instances, and it is doubtful if a clinical distinction in type of eruption can be maintained. Rose spots may be wholly lacking or may be profuse and widely distributed over the body surface. The occurrence of relapses is more frequent in paratyphoid than in typhoid proper, and particularly is that true in connection with type A infections. In contradistinction to the relapse of typhoid, that of paratyphoid is frequently more severe than the original attack. The distinction between mild typhoid, paratyphoid A and paratyphoid B can be made definitely only by the isolation of the infecting organism from cultures of the blood, urine, or stools.

5. *Differential diagnosis*.—Influenza: Many cases originally diagnosed as influenza in the American Expeditionary Forces have subsequently proven to be typhoid. The symptoms which the two diseases have in common are continuous fever without localizing symptoms and slow pulse associated with absence of leucocytosis. The more abrupt onset, the intensity of the headache, the severe pain in the back and eyeballs, and the early prostration occurring in influenza are distinctive. Supposed influenza in which the fever persists for more than four days and which is not associated with signs of respiratory involvement, such as a bronchitis, usually most extensive in the lower lobes, a broncho or lobar pneumonia, should be viewed with suspicion. It should be remembered that a general bronchitis is not uncommon in typhoid. The appearance of rose spots should determine typhoid. Intestinal types of supposed influenza should always be considered as possible typhoid until proven otherwise.

Acute miliary tuberculosis.—A family history of association with tuberculosis individuals, a personal history of previous attack of pleurisy or pulmonary hemorrhages, physical signs of old tuberculous pulmonary lesions, cyanosis appearing early in the disease associated with increased rate of respiration, a greater irregularity of temperature curve, and a more rapid pulse with absence of diastolic murmur suggest acute miliary tuberculosis. Röntgenograms of the chest and blood cultures frequently give valuable differentiation.

Septicemia: In cases of late typhoid admitted to the hospitals during or after three weeks of profound toxemia, together with the, by this time, distinctly remittent temperature, may suggest septicemia. The slight daily fluctuation in the general condition of the patient, together with the absence of chill and leucocytosis, suggest typhoid. Blood cultures will always be made in such cases, and, if negative, cultures of the stools will be made for the presence of typhoidlike organisms.

6. Local and unexplained gastrointestinal derangements, gastritis acute or chronic, diarrhea, dysentery, gastroenteritis, enterocolitis, colitis, appendicitis, cholecystitis, and acute catarrhal jaundice all occurring with or without fever should be regarded with suspicion when admitted from commands in which cases of typhoid or paratyphoid have occurred, and examination of the stools for the presence of typhoidlike organisms should be made.

Medical officers will see that all cases of gastrointestinal derangement enumerated above as well as all fevers of undetermined origin are subjected to careful clinical and laboratory supervision. They will under no conditions be left in quarters but will be sent at once to camp, evacuation, mobile, or base hospitals where accurate observation of temperature at four-hour intervals will be recorded for a period of at least four days. Blood cultures will be taken in every case of fever of undetermined origin in which the temperature has persisted for a period of 48 hours and if negative will be repeated provided unexplained fever persists from the second to the fourth day.

Daily physical examinations of such cases will be made, special attention being paid to physical examination of the abdomen for enlarged spleen, distention, and tenderness, either general or localized. A careful survey of the entire surface of the body will be made for the possible appearance of rose spots.

The precautions appropriate for a case of typical proved typhoid or paratyphoid fever must be observed in all instances where atypical or undetermined fevers are held under observation, awaiting clinical or bacteriological diagnosis of specific enteric infections. The frequency with which atypical, mild, unrecognized cases of typhoid and paratyphoid fever have occurred in the American Expeditionary Forces among vaccinated men makes it absolutely essential to surround all such cases of undetermined fever with the same precautions which it is found necessary to apply to established typhoid or paratyphoid patients, to avoid contact infections in the wards among other patients and hospital personnel.

7. Temperature records, clinical notes, and the original reports of laboratory findings in all cases of typhoid, paratyphoid, fevers of undetermined origin, and the above mentioned list of gastrointestinal

disorders will accompany the patient if transferred to another medical unit and will be preserved and forwarded to the office of the chief surgeon as per instructions contained in Section VI, paragraphs 6-7, Sick and Wounded Reports, for American Expeditionary Forces, September 15, 1918. In no instance will the clinical notes, temperature, and laboratory records of these cases be destroyed upon the completion of the case.

V.—Laboratory Diagnosis of Typhoid and Paratyphoid Fevers.

Bacteriological procedures are of great value (1) for the certain and early diagnosis of suspected cases, (2) to determine carrier state in convalescent positive cases, (3) to detect carriers in otherwise normal individuals.

Blood cultures offer the most certain method for early diagnosis of undetermined fevers, and it should be kept in mind that the earlier in the disease the blood culture is taken the more likely is the result to be positive; thus, in positive typhoid fever, the chance of successful blood culture declines from 90 per cent during the first week to 40 per cent during the third week. In paratyphoid A fever, because of the frequently short and mild febrile period, the prompt and early blood culture is all the more necessary. Relapses are more common in paratyphoid than in typhoid, and taken at such a time, blood culture yields positive results in every case.

The following method of blood culture is recommended as being suitable in all cases of fever of undetermined etiology.

(a) When laboratory facilities are at hand, take 10 c. c. of blood from a vein at the elbow. Place 3 c. c. in each of two flasks containing 100 c. c. of plain broth. Place one c. c. in tube of agar (melted and cooled to 45° C.), immediately mix and pour plate. Place remainder of the blood in dry sterile test tube to separate serum for such serological tests as may be suggested.

The two flasks and plate are incubated and examined the following day. Transplants are made to plain agar slants, or better, Russell's double sugar agar. In case of development of gram-negative motile bacilli or agar slants, emulsions should be made and agglutination tests done with immune sera for final identification.

Frequency of nonagglutinability of recently isolated typhoid cultures should be kept in mind.¹ Negative blood culture in suspected typhoid fever means little. Repeat if clinical conditions indicate.

(a) If the blood culture specimen can not be taken directly to the laboratory, filtered sterile ox bile is most useful, 5 c. c. in a tube. To such sterile ox bile 5 c. c. of blood is added, the tube closed with a sterile paraffin cork, carefully packed and sent for examination to

¹ All strains of organisms of the typhoid paratyphoid group are of special interest and should be sent to the Central Medical Department Laboratory, A. P. O. 721.

the nearest laboratory. Bile medium is furnished in chest No. 1 transportable laboratory, United States Army Expeditionary Force model. Additional supply of this medium may be obtained as needed from Central Medical Department Laboratory A. P. O. 721.

Bacteriological examination of the feces is second only to blood culture as an important means of positive diagnosis. It is especially important in paratyphoid B fever.

Typhoid or paratyphoid carriers.—Typhoid and paratyphoid patients excrete the bacilli, frequently with their urine and practically always in their feces. This is most likely to occur during the third and fourth week of the disease, the condition may persist throughout convalescence and not infrequently longer. It is, therefore, important not to release the convalescent typhoid or paratyphoid fever patient until he ceases to excrete these bacilli.

Three negative cultures of the urine and feces at six-day intervals should be required before release of patient, the first not earlier than one week after temperature curve has become normal.

Some persons who have never had a clinical history of the disease may excrete typhoid or paratyphoid bacilli. It is important to detect such carriers in any occupation, but especially among cooks and handlers of foodstuffs. In such a carrier survey two examinations should be done on each individual.

For release of patients therefore, and detection of carriers, the examination of feces is of especial importance. It is a procedure that properly requires the most careful attention of the bacteriologist. A bit of fresh feces the size of a pea (or better, when feasible, 1 c. c. of liquid stool, obtained, if diarrhea is not already present, by administration of a saline cathartic) is mixed with 10 c. c. of plain broth or sterile salt solution, then allowed to stand and sediment for 15 minutes. One or more loopfuls are taken from the top and placed on the surface of one plate of hardened Endo medium. This droplet is carefully carried over the surface by means of a glass elbow rod or similar spreader and without further inoculation, the same rod is used to seed a second Endo plate. In this way a satisfactory separation of the colonies may be secured. After incubation over night suspicious colonies are fished to plain agar, agar slants, or better, Russell's double sugar, and the identification completed by agglutination tests.

Evacuation of typhoid carriers.—Whenever it becomes necessary or desirable to evacuate a carrier of typhoid or paratyphoid fever to the United States, the carrier shall be evacuated as a patient on sick report.

The Widal test, in view of previous vaccination with T. A. B. vaccine, has been generally held of little or no value; however, it should be stated that the determination of agglutinin titer of patient's

serum at intervals of one week and the demonstration of progressive and marked increase of agglutinin content of the blood offers, especially in the absence of positive blood culture, excellent evidence as to the etiology of the disease. Thus, in typhoid fever an agglutinin titer (Widal test) of 1 to 40 during the first week of the disease may advance to 1 to 1,280 during convalescence. In paratyphoid B fever the titer frequently advances to 1 to 2,560; however, in paratyphoid A fever it may not reach 1 to 640. Formalinized and standardized bacterial suspensions of *B. typhosus*, *B. paratyphosus* A, and *B. paratyphosus* B. may be obtained on request from the Central Medical Department Laboratory, A. P. O. 721.

Post mortem bacteriology.—At autopsy, on suspected cases, cultures should be made from the mesenteric lymph glands and from the spleen.

VI.—Pathology.

1. The significant gross pathology of typhoid fever can be briefly summarized as an acute process found in the lymphoid elements of the intestine (chiefly the ileum) and in the enlargement and softening of the lymph nodes in the mesentery and mesocolon. These nodes in the immediate neighborhood of the lower end of the ileum, the appendix, and cæcum usually show the most marked change. The opened intestinal tract reveals hyperplasia of all the lymphoid elements such as Peyer's patches and the solitary follicles. There may be in most unusual cases only hyperplasia of these elements, but, as a rule they show injection, exudation, and rather extensive ulceration particularly in the lower end of the ileum. The lower third of the ileum is frequently the location of an ulcerated Peyer's patch or solitary follicle that may have perforated or may have become the source of considerable hemorrhage. The mucosa of the appendix and the cæcum are, in about one-third of the cases, also the seat of typhoid ulcers.

The spleen is usually enlarged and the pulp is semidiffuent. The parenchymatous organs are somewhat enlarged and have a cooked appearance suggesting cloudy swelling of a moderate or extreme degree. Broncho-pneumonia is frequently present as a terminal lesion. This represents the usual list of anatomical findings disclosed to gross examination; therefore, on opening the abdomen, the first important gross features that attract attention are the size of the lymph-nodes in the mesentery and the upper part of the mesocolon and the size and consistence of the spleen.

In children these structures may be misleading and in adults afflicted with tuberculosis a confusing gross picture can be offered, but in the Army of the American Expeditionary Forces composed of young adults any such picture found at autopsy should be thoroughly investigated. Such investigation calls for the removal of the in-

testine and an examination of the intestinal mucosa for lesions related to the lymphoid elements. Any change noted should be followed with supporting evidence gained by bacteriological examination.

It should be kept in mind that the American Army has been vaccinated against typhoid, and as a result, the gross pathological picture may not be as clear as in unprotected individuals. Indeed, several protocols received indicate that there are fewer gross lesions in the intestine and that they are prone to appear in the ileum at points very near the ileo-cæcal valve and even in the appendix and cæcum. Other records indicate that death probably occurred during a relapse, since there was evidence of a few almost healed ulcers near the location of one or more acute ulcers, one of which had perforated.

Cases of typhoid may escape attention at autopsy if early and complete regional examinations are not conducted and recorded in a methodical manner, and it is imperative that the pathologist support any suspicion of typhoid fever gained on gross examination by a well-conducted post mortem bacteriological examination. Cultures taken from the gall bladder and from the lumen of the bowel may offer the only positive findings of a "carrier" of the disease. Cultures offering the pathologist the best support may be taken from the spleen and lymph nodes in the drainage path of actual intestinal lesions.

Cases possessing the pathology and bacteriology of typhoid should be entered under the cause of death, at the close of protocol as typhoid fever, and then, if desired, follow in parenthetical manner with any important sequel present, such as "perforation." Several protocols have been received in which the complete pathological and bacteriological pictures of typhoid fever were recorded but the cause of death was entered as "peritonitis," "perforation of the intestine," "broncho-pneumonia," "acute enterocolitis."

Attention is directed to Section XVII of the pamphlet Sick and Wounded Reports (effective Sept. 15, 1918). All diagnoses should conform to these instructions if a proper record of disease is to be made.

VII.—Prevention and Control of Typhoid and Paratyphoid Fevers.

Typhoid fever is increasing in the American Expeditionary Forces—so are the paratyphoid fevers.

Vaccination is a partial protection only and must be reenforced by sanitary measures.

Faulty conditions of sanitation that may not be dangerous now will become serious menaces when the warm weather sets in. There is still time to correct many of these conditions. If this is not done

many soldiers will not get back to the United States after completion of their arduous service and it will be in part your fault and our responsibility.

The means of conveyance are water and food. Water may be contaminated by drainage from latrines and indiscriminately deposited defecations. Food may be contaminated by hands of carriers; by flies that come to it from latrines and uncovered feces; therefore,

Remember: That all water in France is regarded as contaminated unless it is under constant supervision of water supply personnel. See that General Order 131, general headquarters, 1918, is carried out. Don't give orders only—personally assure yourself that chlorination is properly carried out. The responsibility ultimately falls upon those charged with sanitary control and not upon the enlisted man who mixes the hypochlorite of lime with the water. Study the means of prevention of drinking at unauthorized sources. The best way to do this is to see that an adequate supply of supervised water is conveniently available wherever men work or live. Other means are the marking of water points, the removal of faucets, the placing of guards, and last but most important, the education of the men.

Remember: That the most dangerous carriers are the ones that work in the kitchens. Enforce the washing of hands by kitchen personnel before the preparation and serving of food. Do not leave this to orders alone. Have a reliable officer or National Guard officer supervise this, and see that the means of washing are on hand. Also remember that many cooks who have been found to be carriers have often given histories of recent intestinal disturbance; therefore inspect your kitchen personnel at least twice a week and remove all those who are suffering or have recently suffered from diarrheas. Repeated attacks of diarrhea are particularly suspicious.

Remember: That flies breed in manure, feces, and offal of many kinds. Policing of camp and the proper disposal of all such filth will keep down the number of flies. A campaign of such policing if now undertaken should go far to yield results by spring. Flies alone can not spread these diseases if latrines are covered and access to feces prevented. Look at the lids on your latrines. Correct the conditions which lead to uncovered feces in camps. Keep the food covered, so that any flies that get through this cordon can not get at it.

Remember: That an outbreak of diarrhea may mean typhoid fever. At any rate the occurrence of epidemic diarrhea shows that there is a hole in your sanitary plan.

Remember: That even though your camp is a model one the neighboring civilian population may be a source of danger. Try to keep informed of typhoid-like disease in the civilian population where you are stationed.

Remember: That from the sanitary point of view the first case is the most important one. If you evacuate a suspicious case and don't hear what it has turned out to be, make inquiry through the available channels.

Control.

1. Upon the occurrence of a single case of typhoid or paratyphoid fever in a command, reinvestigate all the above conditions and correct any deficiencies discovered in the barrier of protection above described.

Examine all vaccination records and administer a single dose of triple lipo-vaccine to all in whom there is the slightest doubt concerning completion of required vaccination.

Request bacteriological carrier examination of your kitchen personnel from the nearest available laboratory. This had best be done through the responsible sanitary authorities.

Before this has been done reinspect your kitchen personnel and remove all who give a history of recent diarrhea or other intestinal disturbance.

Prohibit the use of all uncooked vegetables and unboiled milk.

Investigate the conditions of the neighboring civilian population as to prevalence of typhoid or typhoid-like fevers.

2. When two or more cases occur in the same command within the same two weeks, revaccinate the entire command in addition to the above precautions.¹ If the outbreak takes on epidemic proportions, add to these precautions the handwashing of all men after defecation.

Further measures of control must be determined after epidemiologic study of the individual situation.

Whenever typhoid or paratyphoid fever occurs in any command, the medical officer will address the officers and the men, at either roll call or retreat, instructing them in the mode of spread of intestinal diseases, in the seriousness of the situation and in the simple methods of personal hygiene, the importance of cleanliness, and the purposes of the sanitary regulations instituted for control of these diseases.

3. The special attention of all officers of the Medical Department is invited to sections 184 and 185, Article III, Manual of the Medical Department. Compliance is enjoined.

4. All previous instructions from this office in conflict with regulations prescribed herein are rescinded.

WALTER D. McCaw,
Colonel, Medical Corps, Chief Surgeon.

¹ Directions for vaccination with Triple T. A. B. lipo-vaccine are being issued with the vaccine.

[A copy of these instructions will accompany each shipment of Vaccine.]

Directions for Vaccination with Triple T. A. B. Lipo-Vaccine.

1. *Records*.—(a) Prepare a list in duplicate of the officers and men of the organization, giving name, serial number and rank. Inspect all those appearing on the list, taking the temperature of any individual who looks sick. No person will be vaccinated who is not in perfect health and free from fever (99.6° F. or over). Keep a record of those who are not vaccinated because of temporary unfitness, and when they are in good physical condition, vaccinate them.

(b) Enter upon the service record and upon the individual pay book the date of vaccination and the type and dose of vaccine given.

2. *Dose*.—A single dose of 1 c. c. of the Triple T. A. B. lipo-vaccine fulfills the vaccination requirements.

3. *Procedure*.—(a) Sterilize the skin with tincture of iodine; warm the vaccine to body temperature to facilitate the flow of the oil; do not overheat (when the vaccine stands in the cold a precipitate may appear, which will disappear on warming).

(b) Shake the ampoule well before loading the syringe.

(c) It is necessary to use a large bore needle (with a well sharpened point, the large bore needle causes no more pain than a small bore needle).

(d) *The injection is to be given subcutaneously*, not intramuscularly or intracutaneously; special care must be taken to avoid introduction of the vaccine into a vein; raise a fold of the skin between the thumb and finger, pass the needle at least one-half inch through the skin into the subcutaneous tissue and then inject the vaccine into the subcutaneous tissue of the fold.

(e) The puncture opening in the skin made by the large size injecting needle tends to permit escape of the oil; to prevent this, press a small iodine swab firmly against the puncture hole for a few minutes or until exudation from the hole has ceased; this procedure will prevent the occurrence of superficial infections which are apt to follow if the puncture hole is permitted to remain open and the clothing is immediately pulled down over it.

4. *Aftercare*.—(a) Avoid rubbing or massaging the site of the injection.

(b) Abstinence from alcoholic drinks must be enforced for two days after the inoculation.

(c) It is advisable to give the vaccine in the afternoon, and to relieve those vaccinated from duty for at least 24 hours, and if local or systemic reaction persists, for a longer period.

PUBLICATIONS RELATING TO TYPHOID FEVER AND WATER SUPPLY.

PUBLIC HEALTH BULLETINS.

51. The Causation and Prevention of Typhoid Fever. By L. L. Lumsden. November, 1911.
68. Safe Disposal of Human Excreta at Unsewered Homes. By L. L. Lumsden, C. W. Stiles, and A. W. Freeman. April, 1915.
69. Typhoid Fever: Its Causation and Prevention. By L. L. Lumsden. May, 1915.
70. Good Water for Farm Homes. By A. W. Freeman. May, 1915.
89. A Sanitary Privy System for Unsewered Towns and Villages. By L. L. Lumsden. August, 1917.
94. Rural Sanitation. A Report on Special Studies Made in 15 Counties in 1914, 1915, and 1916. By L. L. Lumsden. October, 1918.